

Nursery Designs

Table of Contents

- Layouts for crossing blocks 1
 - Paired Plots 1
 - Small Test Cross Block for hand crossing 2
 - Large isolated test cross block with one tester 3
 - Medium sized test cross block with three testers 3
 - Planned Cross Matrix 4
- Nursery designs for characterization 7
 - The Family Plan 7

Layouts for crossing blocks

Paired Plots

The Maize Fieldbook calls this design the North Carolina II design. In the NC II design n1 males are each crossed to n2 females. The genetic analysis of the NC II design supposes that the parental lines are randomly selected from a large F2 population, but the following layout serves to facilitate the crossing of n1 males and n2 females so it inherits the name even though the parents may be any chosen lines.

Example 5 parents with 2 males and 3 females. There will be n1 x n2 crosses and we plant the parents for each cross next to each other so there will be 2 x n1 x n2 plots – first male next to each female, second male next to each female and so on.

TRIAL_INSTANCE	ENTRY_NO	PLOT_NO
1	1	1
1	3	2
1	1	3
1	4	4
1	1	5
1	5	6
1	2	7
1	3	8
1	2	9
1	4	10
1	2	11
1	5	12

To get the cross records for this design you can use the Design Crosses tool and cross the male parents to the female parents in all combinations.

If we want to generate the design directly from the design generation list, the input needed is only the identification of parents as male or female.

Small Test Cross Block for hand crossing

In this design a number of crosses is planned and the parents are planted in a rectangular array with the first column planted to male parents and subsequent columns planted to female parents. This has the same $n_1 \times n_2$ structure as the Paired Plots layout, but is more efficient since one male plot is used to pollinate all female lines. There could be another column of male plots after the female columns which could be planted at a different date to the first column to improve the chances of nicking.

Here is an example of the layout for 5 testers and 5 lines:

Male Testers	Female Line 1	Female Line 2	Female Line 3	Female Line 4	Female Line 5
Plot 1 Entry 1	Plot 2 Entry 6	Plot 3 Entry 7	Plot 4 Entry 8	Plot 5 Entry 9	Plot 6 Entry 10
Plot 7 Entry 2	Plot 8 Entry 6	Plot 9 Entry 7	Plot 10 Entry 8	Plot 11 Entry 9	Plot 12 Entry 10
Plot 13 Entry 3	Plot 14 Entry 6	Plot 15 Entry 7	Plot 16 Entry 8	Plot 17 Entry 9	Plot 18 Entry 10
Plot 19 Entry 4	Plot 20 Entry 6	Plot 21 Entry 7	Plot 22 Entry 8	Plot 23 Entry 9	Plot 24 Entry 10
Plot 25 Entry 5	Plot 26 Entry 6	Plot 27 Entry 7	Plot 28 Entry 8	Plot 29 Entry 9	Plot 30 Entry 10

The way to achieve this design is to use a lay-out file as follows:

	A	B	C
1	TRIAL_INSTANCE	ENTRY_NO	PLOT_NO
2	1	1	1
3	1	6	2
4	1	7	3
5	1	8	4
6	1	9	5
7	1	10	6
8	1	2	7
9	1	6	8
10	1	7	9
11	1	8	10
12	1	9	11
13	1	10	12
14	1	3	13
15	1	6	14
16	1	7	15
17	1	8	16
18	1	9	17
19	1	10	18
20	1	4	19
21	1	6	20
22	1	7	21
23	1	8	22
24	1	9	23
25	1	10	24
26	1	5	25
27	1	6	26
28	1	7	27
29	1	8	28
30	1	9	29
31	1	10	30

To obtain the cross records for this design you can use the Cross Design tool and cross the male testers to the female lines in all combinations.

The input needed to generate this design is only the identification of parents as male or female and the number of columns available in the field for female parents (NFC). The number of female parents, n_2 must be divisible by NFC and then the layout will have $n_1 \times (n_2/NFC)$ rows by $NFC+1$ or $NFC+2$ columns depending on whether you add the extra column of male parents.

Large isolated test cross block with one tester

An isolated crossing block using emasculation and natural fertilization of a lot of lines by a single tester can be achieved by marking the tester as a check. The user wanted two rows of the tester separated by 6 rows of lines and then another two rows of tester. To do this add the tester twice to the list of lines, then mark the tester entries as checks and produce a layout in Entry List Order with checks starting in plot 1, spacing =6, and all checks planted in each position. Now if the field has a multiple of $2+6=8$ columns (eg 24 plots per range) then all the tester rows will line up for simple planting, and all you need to do is plant two extra plots of the tester at the end of each range to ensure an even pollen distribution.

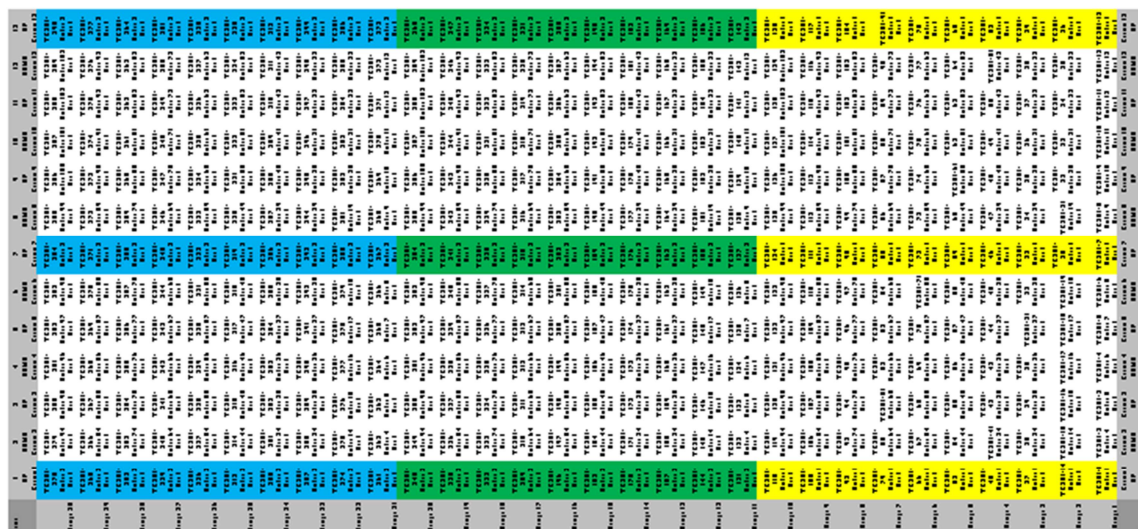
Medium sized test cross block with three testers

Consider an example with 3 testers (entries 1,2,3) and 100 lines (entries 4 to 103). Suppose there are 13 plots per range with three plots for the tester (1,7,13) in each range allowing ten lines per range. The layout requires 10 ranges for each tester, making 30 ranges or 390 plots.

The layout file (TC20d.csv) starts and ends like this with coloured cells indicating testers:

	A	B	C	
1	TRIAL_INS	PLOT_NO	ENTRY_NO	
2	1	1	1	
3	1	2	4	
4	1	3	5	
5	1	4	6	
6	1	5	7	
7	1	6	8	
8	1	7	1	
9	1	8	9	
10	1	9	10	
11	1	10	11	
12	1	11	12	
13	1	12	13	
14	1	13	1	
15	1	14	1	
16	1	15	14	
17	1	16	15	
18	1	17	16	
19	1	18	17	
20	1	19	18	
21	1	20	1	
22	1	21	19	
371	1	370	88	
372	1	371	3	
373	1	372	89	
374	1	373	90	
375	1	374	91	
376	1	375	92	
377	1	376	93	
378	1	377	3	
379	1	378	3	
380	1	379	94	
381	1	380	95	
382	1	381	96	
383	1	382	97	
384	1	383	98	
385	1	384	3	
386	1	385	99	
387	1	386	100	
388	1	387	101	
389	1	388	102	
390	1	389	103	
391	1	390	3	

The fieldmap with 30 ranges of 13 columns looks like this:



Planned Cross Matrix

In this design a number of crosses are planned and the parents are planted in a rectangular array with the first column planted to male parents and subsequent columns planted to female parents. Lines can be both male and female parents, the same male parent can be planted on the first plot of more than one row and the same female parent can be planted more than once in a row (if more seed is desired for a particular cross). A final column of male parents can also be added with a different planting date to the first column to improve the chances of nicking. The problem is to design the crosses so that each male is crossed to a multiple of NFC females – NFC is the number of female columns in the layout. One simplification is where each male is crossed to NFC females in which case each female column is planted with the same female parent line as in the Test Cross Block design.

Example the following array shows the 32 entries assigned to the array for plots.

Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7
1	23	17	19	7	14	22
Plot 8	Plot 9	Plot 10	Plot 11	Plot 12	Plot 13	Plot 14
2	9	20	32	21	23	15
Plot 15	Plot 16	Plot 17	Plot 18	Plot 19	Plot 20	Plot 21
2	26	20	12	31	28	8
Plot 22	Plot 23	Plot 24	Plot 25	Plot 26	Plot 27	Plot 28
3	15	27	25	30	7	21
Plot 29	Plot 30	Plot 31	Plot 32	Plot 33	Plot 34	Plot 35
4	31	10	16	12	30	10
Plot 36	Plot 37	Plot 38	Plot 39	Plot 40	Plot 41	Plot 42
5	24	20	8	27	29	13
Plot 43	Plot 44	Plot 45	Plot 46	Plot 47	Plot 48	Plot 49
6	11	23	12	16	18	19

Given a design and layout as above, the layout file is easily constructed for use with the use my own design feature. The ENTRY_NO column is just the stack of the rows of entry numbers in the field lay-out.

TRIAL_INSTANCE	ENTRY_NO	PLOT_NO
1	1	1
1	23	2
1	17	3
1	19	4
1	7	5
1	14	6
1	22	7
1	2	8
1	9	9
1	20	10
1	32	11
1	21	12
1	23	13
1	15	14
1	2	15
1	26	16
1	20	17
1	12	18
1	31	19
1	28	20
1	8	21
1	3	22
1	15	23
1	27	24
1	25	25
1	30	26
1	7	27
1	21	28
1	4	29
1	31	30
1	10	31
1	16	32
1	12	33
1	30	34
1	10	35
1	5	36
1	24	37
1	20	38
1	8	39

1	27	40
1	29	41
1	13	42
1	6	43
1	11	44
1	23	45
1	12	46
1	16	47
1	18	48
1	19	49

How could this design be generated? In the simple case where n1 males are crossed to n2 females and the layout has NFC female columns where n2 is divisible by NFC then the design is the Test Cross Block described above.

In the general case you need to know which females are crossed to each male, and the number for each male needs to be a multiple of NFC. This is quite a lot of data as in the layout file above. However it could be captured using the Cross Design tool. Build the set of crosses by specifying each male parent in turn with it k*NFC female parents. The list of F1s could be used to construct the layout. (Problem here if you want the same cross twice!)

To actually make the cross records you will need a crossing template which is constructed as follows:

FEMALE PLOT	MALE STUDY	MALE PLOT	BREEDING METHOD	CROSSING DATE	NOTES
2		1			
3		1			
4		1			
5		1			
6		1			
7		1			
9		8			
10		8			
11		8			
12		8			
13		8			
14		8			
16		15			
17		15			
18		15			
19		15			
20		15			
21		15			
23		22			
24		22			
25		22			
26		22			
27		22			
28		22			
30		29			
31		29			
32		29			
33		29			
34		29			
35		29			
37		36			
38		36			
39		36			
40		36			
41		36			
42		36			
44		43			
45		43			
46		43			
47		43			
48		43			
49		43			

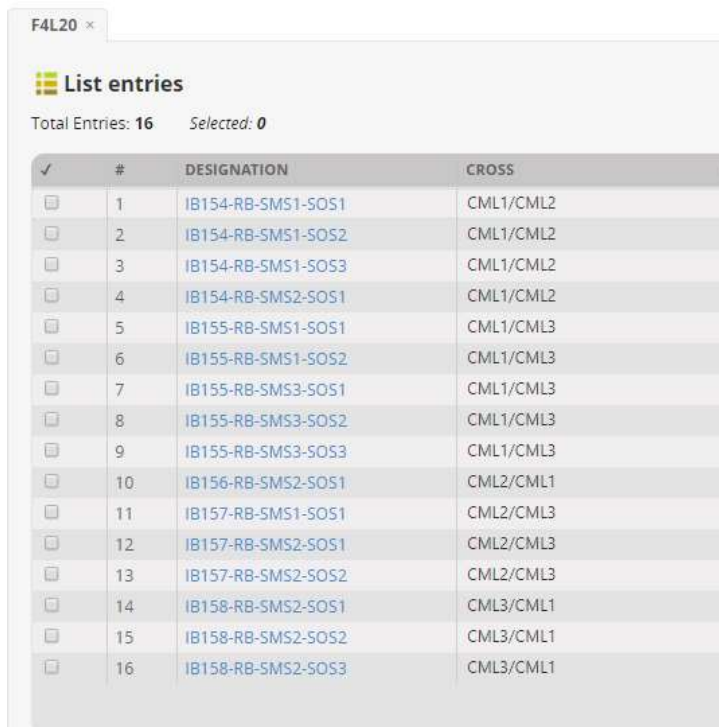
Nursery designs for characterization

The Family Plan

The family plan is a nursery where entries are grouped into sets of lines having common parents and the parents are planted before and/or after their offspring in the layout. Variations are to plant both parents before, or female before and male after, or both before and after or both after.

However once the list of entries has been specified the analysis to obtain the layout is tedious but routine. Sort the entries into families, look up the parents and put them in the layout.

For example suppose we want to make a family plan nursery for the following list of F4 lines, with both parents planted before each family:



The screenshot shows a window titled 'F4L20' with a tab 'List entries'. Below the title bar, it says 'Total Entries: 16 Selected: 0'. The main area contains a table with the following data:

✓	#	DESIGNATION	CROSS
<input type="checkbox"/>	1	IB154-RB-SMS1-SOS1	CML1/CML2
<input type="checkbox"/>	2	IB154-RB-SMS1-SOS2	CML1/CML2
<input type="checkbox"/>	3	IB154-RB-SMS1-SOS3	CML1/CML2
<input type="checkbox"/>	4	IB154-RB-SMS2-SOS1	CML1/CML2
<input type="checkbox"/>	5	IB155-RB-SMS1-SOS1	CML1/CML3
<input type="checkbox"/>	6	IB155-RB-SMS1-SOS2	CML1/CML3
<input type="checkbox"/>	7	IB155-RB-SMS3-SOS1	CML1/CML3
<input type="checkbox"/>	8	IB155-RB-SMS3-SOS2	CML1/CML3
<input type="checkbox"/>	9	IB155-RB-SMS3-SOS3	CML1/CML3
<input type="checkbox"/>	10	IB156-RB-SMS2-SOS1	CML2/CML1
<input type="checkbox"/>	11	IB157-RB-SMS1-SOS1	CML2/CML3
<input type="checkbox"/>	12	IB157-RB-SMS2-SOS1	CML2/CML3
<input type="checkbox"/>	13	IB157-RB-SMS2-SOS2	CML2/CML3
<input type="checkbox"/>	14	IB158-RB-SMS2-SOS1	CML3/CML1
<input type="checkbox"/>	15	IB158-RB-SMS2-SOS2	CML3/CML1
<input type="checkbox"/>	16	IB158-RB-SMS2-SOS3	CML3/CML1

You can sort the list of lines into families by sorting on designation if the naming convention is regular, or on the cross column if it is not. Then add the distinct list of patents to the bottom of the list, so in the example entry 17 is CML1, 18 is CML2 and 19 is CML3

Now make a layout file:

TRIAL_INSTANCE	PLOT_NO	ENTRY_NO
1	1	17
1	2	18
1	3	1
1	4	2
1	5	3
1	6	4
1	7	17

1	8	19
1	9	5
1	10	6
1	11	7
1	12	8
1	13	9
1	14	18
1	15	17
1	16	10
1	17	18
1	18	19
1	19	11
1	20	12
1	21	13
1	22	19
1	23	17
1	24	14
1	25	15
1	26	16